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IMPROVED FUNCTIONALIZATION OF CARBON NANOTUBES

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Field of the Invention

This invention is related to addition of functional groups to collections of

5   carbon nanotubes.

Background of the Invention

Carbon nanotubes (CNTs) have attracted much attention, due to their
extraordinary mechanical properties and their unique electronic properties. A CNT
is topologically equivalent to a two-dimensional graphite sheet rolled into a cylinder,

10   with a cylinder diameter as small as 0.7 nanometers (nm) and with a cylinder length
up to several microns (μm). A CNT can be single walled (SW) or multiple walled
(MW) and can also be fabricated as a nanofiber or other CNT structure. A CNT
can be characterized by its chiral vector components (n,m), which helps determine
tube diameter, electronic properties and other properties. Depending upon the

15   chirality (n-m divisible by 3 or otherwise), a CNT can be conducting (metal-like) or
semiconducting.

CNTs are being studied for applications in high strength/low weight
composites, membranes, mechanical filters, body armor, space suits, electronics,
nano-electro-mechanical systems, heat exchange systems, radiators, chemical

20   sensors, physical sensors, actuators, data storage, computers and other applications.
In some of these applications, chemical functionalization (addition of one or more
specified chemical groups to a basic structure) may be necessary to alter the CNT
properties for particular applications. For example, functionalization of the CNT tip
or the side walls with suitable probe molecules can provide chemical sensors that

25   recognize certain target species and ignore all others. Development of functional
composites may require functionalization of a collection of CNTs to allow the tubes
to be dispersed more easily in a host matrix.

An ideal functionalization process should be clean, produce relatively little
residue for disposal, should be efficient, selective, and reasonably fast, should be

30   scalable to large scale production, should not require use of complex apparatus to